

The documentation and process conversion measures necessary to comply with this revision shall be completed by 6 August 2004.

INCH-POUND

MIL-PRF-19500/297D
 6 May 2004
 SUPERSEDING
 MIL-PRF-19500/297C
 4 August 1999

* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER,
 TYPES 1N1184, 1N1186, 1N1188, 1N1190, 1N3766, 1N3768,
 1N1184R, 1N1186R, 1N1188R, 1N1190R, 1N3766R, 1N3768R,
 JAN, JANTX, AND JANTXV

This specification is approved for use by all Departments
 and Agencies of the Department of Defense.

* The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon semiconductor power rectifier diodes. Three levels of product assurance are provided for each device as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (DO-5).

* 1.3 Maximum ratings. Unless otherwise specified, $T_A = +25^\circ\text{C}$.

Type	V_R	V_{RM}	I_O (1) $T_C = 150^\circ\text{C}$	i_f (surge) at 1/120 s $T_C = 150^\circ\text{C}$	Barometric pressure (reduced)
	<u>V dc</u>	<u>V (pk)</u>	<u>A dc</u>	<u>A</u>	<u>mmHg</u>
1N1184	100	100	35	500	8
1N1186	200	200	35	500	8
1N1188	400	400	35	500	8
1N1190	600	600	35	500	16
1N3766	800	800	35	500	30
1N3768	1,000	1,000	35	500	54

(1) Derate linearly 1.4 A dc/ $^\circ\text{C}$ between $T_C = 150^\circ\text{C}$ to $T_C = 175^\circ\text{C}$.

Storage temperature: $T_C = -65^\circ\text{C}$ to $+175^\circ\text{C}$.

Junction temperature: $T_J = -65^\circ\text{C}$ to $+150^\circ\text{C}$.

1.4 Primary electrical characteristics. $R_{\theta JC} = 0.8^\circ\text{C/W}$ maximum.

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, or emailed to Semiconductor@dscclia.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://www.dodssp.daps.mil>.

2. APPLICABLE DOCUMENTS

* 2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

* 2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

* DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

* DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or www.dodssp.dap.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

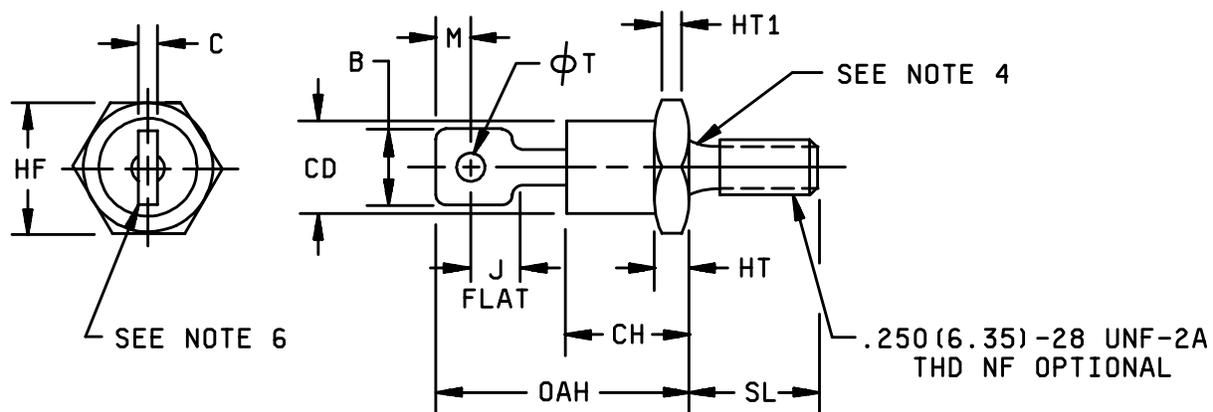
* 3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface and physical dimensions. The Interface and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 (DO-5).

* 3.4.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 Diode construction. All devices shall be in accordance with the requirements of MIL-PRF-19500.



* FIGURE 1. Physical dimensions, (all device types) DO-5.

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Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
OAH		1.000		25.40
CH		.450		11.43
HT	.115	.200	2.93	5.08
SL	.422	.453	10.72	11.50
HT ₁	.060		1.53	
B	.250	.375	6.35	9.52
CD		.667		16.94
HF	.667	.687	16.95	17.44
J	.156		3.97	
φT	.140	.175	3.56	04.44
C		.080		2.03
M	.030		0.77	

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Units must not be damaged by torque of 30 inch-pounds applied to .250-28 UNF-28 nut assembled on thread.
4. Diameter of unthreaded portion .249 inch (6.32 mm) max and .220 inch (5.59 mm) min.
5. Complete threads to extend to within 2.5 threads of seating plane.
6. Angular orientation of this terminal is undefined.
7. Max pitch diameter of plated threads shall be basic pitch diameter .2268 inch (5.76 mm) reference FED-STD-H28.
8. A chamfer or undercut on one or both ends of the hex portion is optional; minimum base diameter at seating plane .600 inch (15.24 mm).
9. Dimensioning and tolerancing shall be in accordance with ASME Y14.5M.

* FIGURE 1. Physical dimensions, (all device types) DO-5 - Continued.

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.5.1 Polarity. The polarity shall be indicated by a graphic symbol with the arrow pointing toward the negative end for forward bias. Standard polarity devices are cathode case. Reverse polarity devices are anode case with an R following the last digit in the type number.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

* 3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4 and tables I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500, and as specified herein. Tests in either polarity shall be sufficient to obtain qualification approval of both polarities.

* 4.2.1 Group E qualification. Group E qualification shall be performed herein for qualification or requalification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table II tests, the tests specified in table II herein shall be performed on the first inspection lot to this revision to maintain qualification.

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* 4.3 Screening (JANTXV and JANTX levels only). Screening shall be in accordance with table IV of MIL-PRF-19500 (appendix E), and as specified herein. Specified electrical measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	JANTXV and JANTX level
1a	Not required
1b	Required (JANTXV only)
2	Not required
3a	Required
3b	Surge (see 4.3.1)
(1) 3c	Thermal impedance (see 4.3.2)
4	Not applicable
5	Not applicable
6	Not applicable
7a	Optional
7b	Optional
8	Not required
9	V_{F2} and I_{R1} (2)
10	Not applicable
11	Not applicable
12	Method 1038 of MIL-STD-750, condition A t = 48 hours
13	Subgroup 2 of table I herein; V_{F2} and I_{R1} ; $\Delta V_{F2} = .1$ V(pk) from initial value; $\Delta I_{R1} = 100$ percent of initial reading or ± 5 μ A dc, whichever is greater (3)
14a	Required
14b	Required
15	Not required
16	Not required

- (1) Surge shall precede thermal response. These tests shall be performed anytime after screen 3 and before screen 9.
- (2) I_{R1} measurement shall not be indicative of an open condition.
- (3) PDA of screen 13 shall apply to screen 11.

* 4.3.1, Surge current. Surge current, method 4066 of MIL-STD-750. $I_O = 0$; $VRM(W) = 0$; $I_{FSM} = 275$ A; six surges; $T_A = 25^\circ\text{C}$; $t_p = 8.3$ ms; one minute minimum time between surges.

* 4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3101 of MIL-STD-750. The thermal impedance conditions and maximum thermal impedance limit shall be derived by each vendor. The chosen thermal impedance measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and a thermal impedance curve shall be plotted. The chosen thermal impedance values shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. Heating current (I_H) \geq rated I_O ; $t_H = 150$ to 400 ms; $t_{MD} = 50$ to 300 μ s; 50 mA $\leq I_M \leq 250$ mA.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

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4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IVb (JANTX and JANTXV) of MIL-PRF-19500, and herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table III herein.

4.4.2.1 Group B inspection, table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500.

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
*	B2	1051	-55°C to +175°C, 25 cycles.
*	B2	4066	Condition A, $T_C = 175^\circ\text{C}$; $V_R = \text{rated } V_R$ (AC peak) (see 1.3), i_f (surge) = 500 A; $I_O = 35$ A dc average; six 1/120 s surges. 1 minute minimum time between surges. $t_p = 8.3$ ms.
		or	Test condition C; $T_A = T_C = T_J = 175^\circ\text{C}$; $V_R = \text{rated } V_R$ (AC peak) (see 1.3), $I_O = 0$; $I_{FSM(\text{surge})} = 500$ A; six surges 1/120 s, $t_p = 8.3$ ms, one minute minimum time between surges.
	B3	1037	0.25 rated $I_O \leq I_O$ applied \leq rated I_O (see 4.5.1) 2,000 cycles.
	B3	1038	Condition A; 340 hrs.
	B5		Not required

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table III herein.

4.4.3.1 Group C inspection, table VII of MIL-PRF-19500.

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
*	C2	1056	0°C to +100°C, 10 cycles.
	C2	2036	Test condition A, weight = 15 pounds, t = 15 s.
	C2	2036	Test condition D1, terminal torque = 3 pound-inches, t = 15 s.
	C2	2036	Test condition D2, stud torque = 30 pound-inches, t = 15 s.
*	C5	3101 or 4081	$R_{\theta JC} = 0.8^\circ\text{C/W}$ maximum; $I_M = 50 - 250$ mA; $I_H \geq \text{rated } I_O$; $t_H = 150$ to 400 ms; $t_{MD} = 50$ to 300 μs .
	C6	1037	0.25 rated $I_O \leq I_O$ applied \leq rated I_O (see 4.5.1) 6,000 cycles.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500, and table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta measurements shall be in accordance with table III herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

* 4.5.1 DC intermittent operation life. A cycle shall consist of an "on" period, when power is applied suddenly, not gradually, to the device for the time necessary to achieve a delta case temperature of 85°C +15°C -5°C followed by an "off" period, when the power is suddenly removed, for cooling. Auxiliary (forced) cooling is permitted during the off period only. $30 \text{ s} \leq t_{\text{Heating}} \leq 60 \text{ s}$, $P = V_F \times I_F$ or $P = V_{\text{FPK}} \times I_{\text{av}}$ if using sine wave current. DC full wave current (or equivalent half sine wave current) shall be used for the power required during the on period. The test power, or current, shall be at least the free air rating. Within the time interval of 50 cycles before to 500 cycles after the termination of the test, the sample units shall be removed from the specified test conditions and allowed to reach room ambient conditions. Specified end-point measurements for qualification and verification shall be completed within 96 hours after removal of sample units from the specified test conditions. Additional readings may be taken at the discretion of the manufacturer.

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* TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Forward voltage	4011	$t_p < 8.3 \text{ ms}$, duty cycle ≤ 2 percent pulse $i_f = 110 \text{ a(pk)}$	V_{F2}		1.4	V dc
Reverse current	4016	DC method $V_R = \text{rated } V_R$ (see 1.3)	I_{R1}		10	$\mu\text{A dc}$
Thermal impedance	3101	See 4.3.2	$Z_{\theta JX}$.8	$^{\circ}\text{C/W}$
<u>Subgroup 3</u>						
High temperature operation:		$T_C = 150^{\circ}\text{C}$				
Reverse current	4016	DC method $V_R = \text{rated } V_{R(pk)}$ (see 1.3)	I_{R2}		1	mA dc
<u>Subgroups 4 and 5</u>						
Not applicable						
<u>Subgroup 6</u> <u>2/</u>						
Forward voltage	4011	$I_F = i_{f(surge)}$; $t_p = 800 \mu\text{s}$	V_{F1}		2.5	V dc
Forward voltage	4011	$I_F = i_{f(surge)}$; $t_p = 8.3 \text{ ms}$	V_{F1}		2.3	V dc
<u>Subgroup 7</u>						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

2/ V_{F1} shall be performed with either $t_p = 800 \mu\text{s}$ or $t_p = 8.3 \text{ ms}$.

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* TABLE II. Group E inspection (all quality levels) for qualification and requalification only.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling	1056	100 cycles, 0° to 100°C	
Electrical measurements		See table I, subgroup 2 herein.	
<u>Subgroup 2</u>			22 devices c = 0
Steady-state dc blocking life	1038	1,000 hours, condition A; $V_R = V_{RM}$	
Electrical measurements		See table I, subgroup 2	
* <u>Subgroup 3</u>			3 devices c = 0
DPA	2101	Decap analysis.	
* <u>Subgroup 4</u>			
Thermal impedance curves		Each supplier shall submit their (typical) max design maximum thermal impedance curves. In addition, the optional test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	
<u>Subgroup 5</u>			22 devices c = 0
Barometric pressure, reduced (altitude operation)	1001	Pressure (see 1.3); t = 1 min. DC method; $V_R = V_{RM}$ (see 1.3); I_{R1} = should be monitored and shall not exceed table I limits.	
<u>Subgroup 6</u>			
Not applicable			
<u>Subgroup 7</u>			
Not applicable			

* TABLE III. Groups B, C and E delta electrical end-point measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	$I_F = 110 \text{ a(pk) dc } t_p < 8.3 \text{ ms,}$ duty cycle ≤ 2 percent pulse.	ΔV_{F2}	±50 mV dc maximum change from previous to post intermittent life and thermal shock measurement tests.		
2.	Reverse current	4016	DC method, $V_R = \text{Rated } V_R(\text{dc})$ (see 1.3)	ΔI_{R1} 4/	100 percent or 5 μA , (whichever is greater) change from initial table I reading.		

- 1/ The delta electrical measurements for table VIb (JAN, JANTX and JANTXV) of MIL-PRF-19500 are as follows:
Subgroup 2, see table III herein, step 1.
- 2/ The delta electrical measurements for table VII of MIL-PRF-19500 are as follows:
a. Subgroup 2 see table III herein, step 1 (JAN, JANTX and JANTXV).
b. Subgroup 6, see table III herein, step 1 (JAN, JANTX and JANTXV).
- 3/ The delta electrical measurements for table IX of MIL-PRF-19500 are as follows:
a. Subgroup 1 see table III herein, step 1.
b. Subgroup 2, see table III herein, step 2.
- 4/ Devices which exceed the group A limits for this test shall be rejected.

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML No. 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000 or e-mail vqe.chief@dla.mil.

* 6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2829)

Review activities:
Army - AR, MI, SM
Navy - AS, MC, OS
Air Force - 19

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